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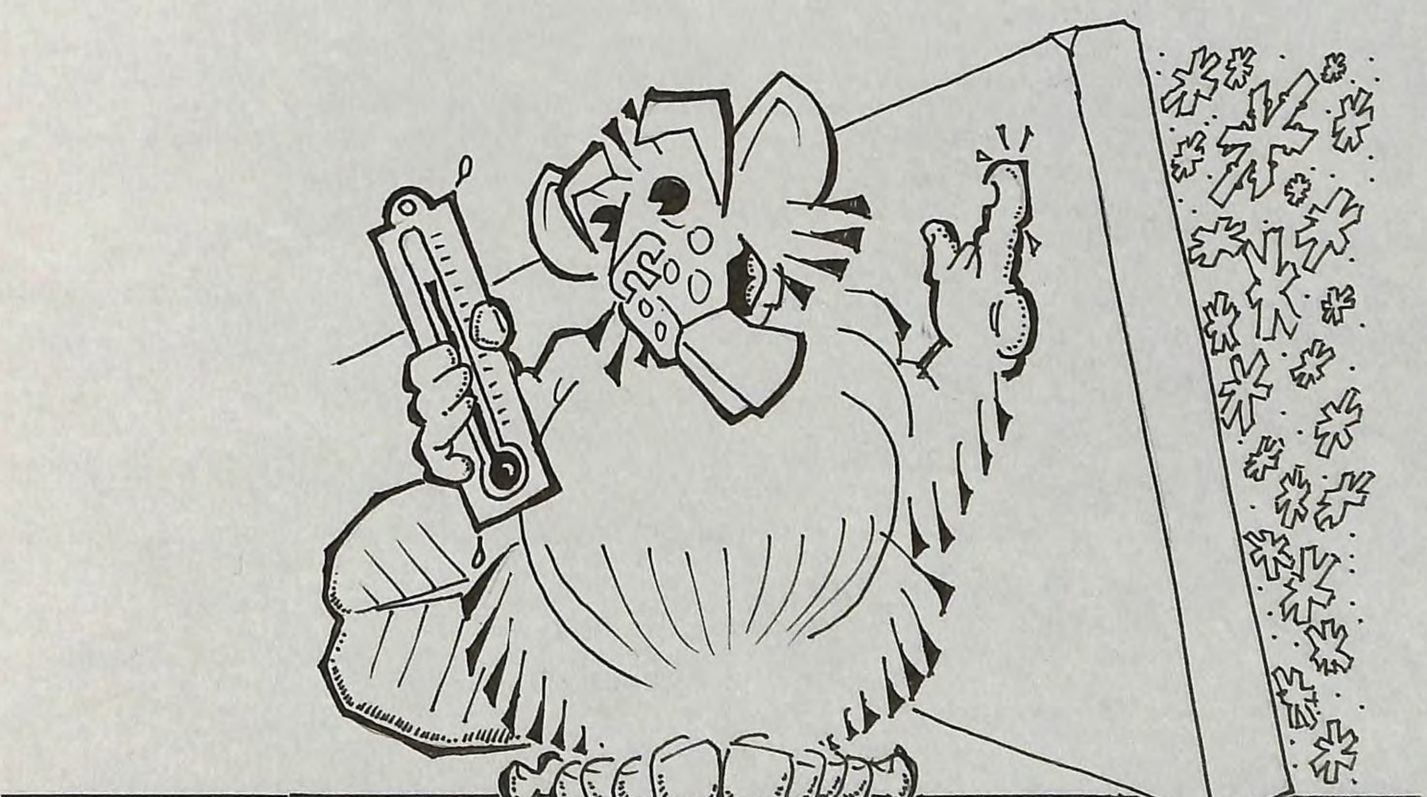
Wall Energy Ratings



From the Editor . . .

I was going to comment on coming changes to new home construction. New energy standards are starting to enter into force. A number of jurisdictions are setting especially aggressive performance requirements, and it is going to have a big impact on the housing industry.

However, as we were putting this issue to bed, the federal government made a sudden move that will have big repercussions on this industry, and one that sends out a questionable message. We know that this government is living in denial about climate change and the need to take concrete action to reduce human impact on the global ecosystem. Their action reinforces this image.

Much of the action that needs to be taken and that is going to have an impact on dealing with the climate change issue will not have a high profile, nor create photo opportunities for politicians. Rather, the result of many small actions will, cumulatively, have big impacts. Home energy retrofits are one of the small actions that will have long-term impact, both for the homeowner, and the community at large.

The ecoEnergy program, which started as EnerGuide for Houses, offered a small incentive for energy efficiency upgrades. The incentives that homeowners received were not big, but enough to motivate action, and as we know, retrofit activity is challenging because you need to work around existing construction and occupants.

At a time when the economy has gone through a bad recession, is still wobbly and stimulus funding is still important, the government seems to have shut down an effective job creation program. It not only contributed to job creation, but also made a significant contribution to making existing housing stock more energy efficient – with lasting benefit.

The EnerGuide labels also provided the homeowner and financing institutions with a credible third party certificate indicating the home's performance, before and after, the work was done.

At the end of March, with little notice, the program was suddenly shut down. It is not even clear in what form the labelling program itself will remain, although a review of the labelling program is underway because a number of provinces are using it as part of their regulatory requirements.

I wonder if the activity involved multinational corporations, and funding in the hundreds of millions, with a heavy investment in petrochemicals, would the program have been shut down the way the ecoEnergy program was?

Although it is not sustainable to prop up an industry with incentives and grants, just for the sake of supporting an industry (I wonder how the oil patch justifies it), there is a public policy role for government, and incentives are one of the tools the government can use.

Eliminating incentive support for home energy retrofits at this time, when other governments in the world are ramping up theirs as a way to address two issues at once (job creation and environmental issues), only reinforces the impression that there is little concern on the part of the government with energy and environmental issues. That they don't get what energy and environment are all about; they don't understand how fragile the earth's ecosystem really is, and what our part in it is.

Sad too, that they don't seem to care about what happens to the next generations – their children and grandchildren – who are going to be the inheritors of the mess we seem to be creating. Then again, maybe they really believe some of the millennial nonsense that the end of the world is nigh, in which case it doesn't really matter what might happen in the future.

Richard Kadulski,
Editor

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e-mail: solplan@shaw.ca
Street address:
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Wall Energy Ratings

Insulation values used in walls have typically been identified only by the R-value of the insulation materials used. Thus R-20 insulation put into a 2x6 stud wall has been considered to be an R-20 wall. However, we know that the effective R-value of a wall is going to depend not just on how much insulation is installed, but also on the way the wall is built, including the thermal bridging across the framing.

The performance of an insulation system is also dependent upon other factors including mean temperature, temperature difference, heat-flow direction as well as wind, air leakage and moisture content of the materials.

In recent years, the focus of building code and regulatory officials, professionals and researchers has shifted towards the performance of the entire wall system and the control of heat, moisture and air through the system. The new energy codes coming into force are increasingly focused on the *effective* R-values of construction assemblies, so that it is not enough to describe the wall by its R-value alone, as was the case in the past.

With the increased use of new insulation products, new ways to detail construction assemblies, and a desire for higher performance buildings, we need new evaluation tools to tell us what the insulation levels are, especially as codes are moving in the direction of effective thermal performance values.

Until recently, most insulation products were fibrous batts – either fibreglass or mineral wool. The standard testing methodology is that defined by the ASTM standard using a "Guarded Hot-Box Testing apparatus". This test method takes a laboratory measurement of heat transfer through a specimen under controlled air temperature, air velocity, and thermal radiation conditions in a chamber with known conditions on either side.

Guarded hot-box testing, although it does have explicit standards, is also an art, because heat transmission is complex and three-dimensional. Testing methodology has been evolving, but there is still a significant measurement uncertainty when construction assemblies are being tested. Although thermal performance testing of building products was pioneered in the 1940s when scientists began the systematic study of thermal resistance of all kinds of materials, the evaluation of the insulation properties of building materials was given a big boost by the energy crisis in the 1970s.

Today concerns are being expressed that the guarded hot-box method of measuring insulation performance is not good enough, as its focus is just on the thermal conductance of the material.

With the increasing use of rigid foam products, spray foam, as well as loose fill blown-in batts, each with its own properties, the *effective* R-values for the construction assembly where they are used can vary.

Materials such as spray polyurethane foam (SPF) and rigid foam boards can also be a part of the air barrier system, and also contribute to moisture management. The behaviour of SPF in the field also depends greatly on installation practices and on its aging and weathering behaviour.

For a truly representative calculation of the effective R-value, we should be considering not only the thermal conductance, but also the air permeance of the wall assembly. How to do this is still the subject of industry debate.

A proper assessment of the thermal and air leakage control characteristics of an SPF insulated assembly needs to incorporate all of these factors. Manufacturers for each product are starting to apply claims, focusing on the strengths of their own products.

Spray Polyurethane Foam insulation (SPF) has been gaining considerable attention for a number of reasons, including: the claimed better thermal performance of foamed walls relative to conventional poly-wrapped batts insulated walls; better air leakage performance; and the introduction of environmentally friendly blowing agents to reduce green house gas emission.

A few years ago, the spray foam industry joined forces to develop a replacement of the commonly used chlorofluorocarbon blowing

> WER: A tool for wall energy rating
>
> WER: Wall Energy Rating (W/m^2) takes into account Conduction heat loss, which is always negative, and Air leakage heat loss which also is negative.

What is Wall Energy Rating (WER)?

A tool for energy rating of wall assemblies that addresses the building physics and accounts for:

- Heat loss due to thermal conduction through the system
- Heat loss due to air leakage through the system
- Interaction between the two modes of heat loss.

The WER Provides a means to assess the overall performance of the system.

agent. More recently, they have been engaged in a research project conducted jointly by the National Research Council Institute for Research in Construction (NRC-IRC) to assess the overall performance of insulated walls.

The objective of the research project was to develop an accurate and reliable procedure to determine the Wall Energy Rating (WER) of insulated wall assemblies. The intent was to introduce a new concept that could combine the heat loss due to air leakage and thermal conduction and showing their interaction and impact on the overall thermal performance of wall assemblies. Walls studied were built according to field practices, with spray from several different polyurethane foam insulation products. Conventional walls with poly-wrapped and sealed insulation were evaluated as reference walls.

The intent for the WER would be to have some a rating tool similar to the ER rating of windows.

Testing was done on a series of test walls built using conventional 2" x 6" wood stud frame construction. Two reference walls were filled with poly-wrapped and sealed glass fiber batts and four walls insulated with closed cell medium density (2-pound) spray polyurethane foam. The foam insulation was sprayed to a 75mm nominal thickness.

A test was also done with open-cell spray foam insulation (also known as half-pound foam, except that the full stud cavity depth was insulated.

Air leakage testing of all the medium density and open cell foam samples showed they performed better than the code requirement of 0.05 l/(s·m^2) for an air barrier material. To the surprise of some, the half-pound open cell foam was more air tight than the code requirement and in most cases out-performed the medium density foam.

The fiberglass reference wall had a measured air leakage of 0.62 l/s.m^2 @ 75 Pa pressure. The Wall Energy Rating dropped from 36 with no air leakage down to 11 with the 0.62 l/s.m^2 @ 75 Pa pressure leakage rate.

The low-density open cell foam wall assembly with penetrations had a measured air leakage rate of 0.022 l/s.m^2 @ 75 Pa. pressure. This is the lowest air leakage rate for all of the assemblies. The Wall Energy Rating dropped from 38 with no air leakage down to 37 with the 0.022 l/s.m^2 @ 75 Pa pressure leakage rate. This is the best performing wall assembly with results far better than the reference assembly and even better than the medium density closed cell foam insulation.

It also should help address the question of whether or not open cell (half-pound) spray foam is an air barrier material.

The research also showed it is possible to determine the energy performance of insulated wall assemblies, with and without penetration with a minimum of laboratory testing. Computer simulation was found to be very useful and accurate in predicting the R-value of the wall, with and without air leakage. Now it is necessary to include additional materials and construction practices into the software to make it easy to assess alternative assemblies. The next step identified is to develop new national (and international) standards that can facilitate the use of the new concept. ☼

... the half-pound open cell foam was more air tight than the code requirement and in most cases out-performed the medium density foam.

Effective Thermal Insulation Values

The effective R-value of a construction assembly needs to consider not only the insulation, but also all other elements, including siding materials, sheathing, framing, exterior finishes – even the thin layer of air at the surface (both inside and out) and whether or not it is still air or windy.

As long as walls had minimal amounts of insulation, the impact of framing or other thermal bridges was not significant. With today's higher insulation levels, it is much more important. Tests have also shown that actual insulation levels can vary depending on the nature of the material, and how it is installed. Even small thermal bridges and poor installation practices can impact actual performance.

Average effective R-values of wood frame walls are calculated by assuming parallel heat flow paths through areas with different thermal resistances. This means you calculate the R-value at the framing and at the insulation, and then average it based on the area of each, as a ratio of the total area. This is done at conditions that: assume conditions are at equilibrium or steady state, not subject to constant fluctuations; disregard effects of heat storage; assume surrounding surfaces are at ambient air temperature and the exterior wind velocity is 24 km/h.

In the case of materials with high conductivity, such as metals, this approach is not appropriate. Recent findings show that the influence of the metal is much greater than just the dimension of the metal profile.

The effective insulation value of assemblies is much more complex, and has led to the desire to come up with new assessment tools, such as the WER (wall energy rating).

In the absence of agreed upon evaluation tools, we still have to work with the conventional R-values, but can calculate the effective assembly performance using tools such as those incorporated in HOT-2000. To see how effective R-values can vary, we looked at a number of typical assemblies and their effective R-value, using HOT-2000. ☼

Wall Insulation Values

Framing	Spacing	Insulation	Nominal R-value	Calculated Effective R-value	
2x4	16" o/c	R-12 fiberglass	R-12	11.40 12.37	Wood siding
2x4	24" o/c	R-12 fiberglass	R-12	11.82 12.79	Wood siding
2x4	16" o/c	R-12 fiberglass + R-5 XPS	R-17	17.26	
2x6	16" o/c	R-20 fiberglass	R-20	17.1 17.5	Wood siding
2x6	24" o/c	R-20 fiberglass	R-20	17.15 18.12	Wood siding
2x6	24" o/c	R-22 fiberglass	R-22	19.25 19.82	Vinyl siding
2x6	16" o/c	R-20 fiberglass + R-5 XPS	R-25	21.53	
2x6	24" o/c	R-20 fiberglass + R-7.5 XPS	R-27.5	26.75	
10" double wall	2 - 2x4 @ 16"	R-12 + R-8 + R-12	R-30	27.48	
6" SIP		5.5" EPS core	R-22	24.64	
8" SIP		7.5" EPS core	R-30	32.63	

Calculated values assume a ½" interior gypsum board finish, cement stucco exterior finish on plywood sheathing, except as noted.

Understanding Building Science

Designs for exterior walls for buildings have rarely been developed in a systematic, rational way. Rather, they have evolved slowly with changes in social and economic patterns and environmental requirements. Today many new materials, components and construction techniques are available – a large number of new assembly designs are possible.

It is unfortunate when building officials lack the understanding of basic building science, or are not allowed any discretion to apply building science principles when evaluating what are considered new construction details – due to edicts from municipal lawyers to minimize possible perceived liability exposure – and it impacts their administration of the building code.

We have recently come across a couple of rather troubling incidents where building officials seem to have taken a questionable tack when evaluating non-standard construction assemblies. In particular, these questionable evaluations have been applied to exterior insulated walls details that follow a highly recommended approach to achieve high performance walls. These involve the use of rigid insulation on the outside of wood frame walls.

Moisture performance of wall assemblies is influenced by:

- ☞Amount of insulation
- ☞Interior vapour control strategy
- ☞Type of cladding
- ☞Drained and ventilated cavity behind cladding (rain screen)
- ☞Exterior insulating sheathing

Moisture-related problems:

- ☞Moisture must be available,
- ☞There must be a route or path for the moisture,
- ☞There has to be a force to move the moisture,
- ☞The material must be susceptible to damage.

Exterior Insulation:

- ☞Increases the wintertime temperatures of the interior wood components
- ☞Increases the average relative humidity and decreases the equilibrium moisture content
- ☞Reduces the potential for air leakage condensation

Foam Exterior Insulation:

- ☞Stops vapour diffusion,
- ☞Disconnects sensitive interior materials from wet, absorptive claddings,
- ☞Limits the amount of drying that can occur from the OSB to the outside,
- ☞Offers improved energy performance,
- ☞Reduces the air leakage condensation potential,
- ☞Reduces equilibrium moisture content for wood components,
- ☞Means less sensitivity to cladding moisture levels

Insulating Sheathing

A conventional wood frame wall typically has about 25% of the area in solid wood (the studs and plates) so only about 75% of the wall has full depth insulation. That is why a 2x6 frame wall with a R-20 batt will have a much lower effective R-value.

The R-value of wood is about 1.2 per inch thickness, while for fibreglass it is about 3.3 or a bit more for the high-density batts and even more for spray foam insulation. In the old days when 2x4 framing was the norm, the effective R-value was close to that of the batt, once all the other construction materials were factored in. But that is no longer the case today with 2x6 framing being the norm.

With the move to more energy efficient building construction, high insulation assemblies are becoming the norm. The EQuilibrium™ houses are being built with extremely high R-values, most being double wall assemblies.

Sheathing the wall with rigid insulation overcomes the thermal bridging of conventional framing. Because the wall area represents a large portion of the building envelope, any improvements that can be made will result in significant building energy performance gains. High volume production builders in many parts of the country have found that sheathing the walls with rigid insulation is do-able, even in the high volume production environment.

We recently were alerted to a case where a homeowner in Surrey, BC, doing due diligence to design a home that was going to be energy efficient, was not allowed to build a house with a 2x6 wall with 1" of extruded polystyrene sheathing insulation. The City of Surrey building department would not permit the use of the detail, despite the fact that the construction assembly meets the specified requirements of the BC Building Code (which is identical to that of the National Building Code).

The homeowner, not a building professional, did enough research that he was able to provide the City with a 5-page report, including references and supporting documentation, with comments from a number of experts including product manufacturer technical information, but to no avail. I suspect the gentleman could now put a number of builders and building officials to shame with his understanding of building science. Regrettably, it was not enough to sway the City's building department.

Section 9.25.1.2 of the code refers to the ratio of thermal resistance outboard of the inner face of an impermeable surface (the extruded polystyrene) compared to the total thermal resistance in the wall. The acceptable ratio depends on the climate zone – the milder the climate, the smaller the ratio, the colder the climate, the higher the ratio. In the case of Surrey (less than 4999 degree-days) the allowable ratio is 0.20. In other words, in the case of coastal BC, at least 20% of the R-value must be outboard of the low permeance surface, which in the case proposed, is the interior side of the extruded polystyrene. In a colder climate, the minimum ratio would be different, with more insulation needed on the exterior.

The calculation of the thermal ratio is a relatively simple procedure, and is laid out in an appendix note (A-9.25.1.2). The calculation takes into account the insulating influences of all elements in an assembly, including air films and each material layer.

A major concern many have is to avoid having a vapour barrier on both sides of an assembly — i.e. "double vapour barriers" – because all assemblies need to be able to dry in at least one direction. Questions are raised about the ability of an assembly to dry water that may be trapped between the low perm foam insulations and moisture sensitive wood sheathings.

Although we need to control vapour diffusion, it is still important to use assemblies with a degree of permeability so that some vapour movement can take place through somewhat vapour permeable materials to enable drying. In heating climates (all of Canada) the vapour diffusion resistance must be placed on the interior.

It is also important to remember that polyethylene is not the only acceptable vapour barrier. Extruded polystyrene, as well as medium density (2-pound) spray in place foam insulation has a sufficiently low permeability to be considered as a vapour barrier. However, these products have a slightly greater permeability (depending on thickness – 25-90 ng/Pa-s-m^2) that still allows a small amount of drying.

As important as vapour barriers are, we must not forget that it is more important that the air barrier be continuous, as it is the air movement through the assembly that is by far the larger driving force for moisture into the assembly.

With coming changes to the building codes, there is going to be more need for review of alternate construction assemblies, since codes are moving away from nominal R-values to effective R-values. There is going to be a need to find a way to properly assess innovative construction approaches so that authorities having jurisdiction will not be able to dismiss innovative or out-of-the ordinary construction approaches or building materials. ☼

Functions of a Wall

It is important to recognize that the overall function of an exterior wall is to provide a barrier between indoor and outdoor environments, so that the interior can be maintained within acceptable limits. The requirements for a wall thus must remain in place and be durable for the required length of time, while providing the necessary barrier or filter to wind, rain, solar radiation, heat, noise, fire, particulate matter, insects, animals and even humans.

A complete list of all possible requirements could be a very long one. The principal requirements of a wall include:

1. Control heat flow;
2. Control airflow;
3. Control water vapour flow;
4. Control rain penetration;
5. Control light, solar and other radiation;
6. Control noise;
7. Control fire;
8. Provide strength and rigidity;
9. Be durable;
10. Be aesthetically pleasing;
11. Be economical.

Any such list is a compromise and, inevitably, there are overlaps between items so that it is necessary always to consider several of these requirements simultaneously.

Items 1 to 7 relate to the wall as a separator between indoor and outdoor environments. An actual or potential flow of matter or energy is involved. The greater the difference between the inside and outside environment, the greater is the stress on the wall. Thus, the wall assembly must be built so that in the first instance it provides the

necessary resistance to keep heat, moisture, air and other flows within acceptable limits.

The way materials are arranged is important, because this will define the conditions in the wall that may affect their performance and durability. Specific wall assembly designs must be sensitive to climate and to cladding type (vinyl siding, brick or stone veneer, stucco).

The environment at any plane in the wall can be determined by the arrangement and selection of the materials used.

Once the outdoor environment and indoor environmental conditions are established, then it is possible to assess the overall performance requirements of the wall.

The indoor relative humidity is an important factor needed to properly design exterior walls for cold weather conditions. Relative humidity, either indoors or outdoors, is a problem mainly when, at the temperature at which it is measured, the surface temperatures are at or below the dew-point condition

In Canada, the major concern is for situations that occur in the winter when the dew-point temperature indoors greatly exceeds that outdoors. In these cases provisions have to be made in the wall for the control of heat, moisture, air and water vapour. High relative humidities indoors with low temperatures outdoors introduce the possibility of wetting on the surface as well as within the wall. The thermal and moisture gradients can be examined to determine the effect of the environment at any plane in the wall on the materials selected for its construction.

From Canadian Building Digest No. 48
Originally published December 1963

Caution About Manufacturer Claims

Industry and regulators rely on third party product testing and reviews. It is unfortunate when product manufacturers misuse product certifications to make inappropriate and misleading claims. In the marketplace, a third party certification or label is an asset, demonstrating that the product has been evaluated by a recognized evaluation service organization.

Recently it has come to light that Amvic Building System, an Ontario-based manufacturer of insulated concrete forming systems is making inappropriate claims for their flat-sheet expanded polystyrene (EPS) insulation material. The product is an EPS sheet covered with a layer of reflective lamination on both sides, and marketed as SilveRboard®. They are claiming that their EPS board stock is a Type 4 product, with the higher R-value associated with Type 4 foam boards, which is not the case.

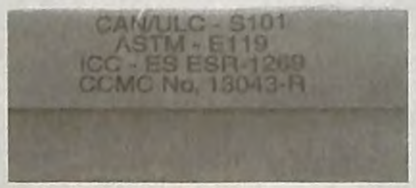
Expanded polystyrene boards can be used effectively in many applications. However, the manufacturer's claims that the product is also available as a Type 4 board, which would mean it has physical and thermal properties similar to those of extruded polystyrene (XPS), are simply wrong. No EPS products can meet the R-5/inch insulation value (RSI 0.87/25mm) that is typical of extruded polystyrene rigid foam insulation.

No EPS products can meet the R-5/inch insulation value typical of extruded polystyrene foam insulation.

Expanded polystyrene, often referred to as beadboard, is manufactured by expanding styrene pellets with steam and pressure. Flat boards are cut to size from large billets. The maximum R-value of EPS is about R-4 per inch thickness. Depending on its density, it is referred to as Type 1, Type 2 or Type 3. There are no EPS products that are able to meet Type 4 requirements.

Type 4 foam boards are higher density and always extruded polystyrene with an R-value of 5 per inch thickness.

As well as misleading performance claims, the product is being bundled and incorrectly marketed with certification marks that do not apply to the product.



The CCMC product evaluation held by Amvic (13043-R) is for their insulated concrete forming, and not for board stock.

The improper claims have aroused the interest of a competitor, who purchased samples from regular distributors and had the product tested by independent third party testing laboratories in accordance with accepted testing standard protocols. The testing labs determined that the product met the criteria for a Type 1 and Type 2 foam board, with a maximum R-value of 4.3/inch thickness.

http://www.amvicsystem.com/EPSProducts/SilveRboardInsulation/tabid/78/Default.aspx

EQuilibrium™ houses: the future of housing

We are seeing a change in the way many people think about their homes. Recent volatile energy prices, greater concern for the environment and a heightened awareness of indoor and outdoor environmental health concerns has increased interest in homes that are healthy, comfortable and energy efficient.

The EQuilibrium™ initiative brings the private and public sectors together to build and showcase the next generation of sustainable housing in Canada. It is a demonstration initiative led by Canada Mortgage and Housing Corporation (CMHC), with the support of Natural Resources Canada (NRCan).

CMHC is not contributing toward the construction costs of the homes, but rather it is providing technical, marketing and monitoring support. CMHC is also helping to disseminate information gained with the homes, to let the industry understand what the builders have found that works or doesn't work with current approaches.

Through a national design competition, CMHC engaged builder-led teams to design, build and demonstrate some of the most sustainable homes ever seen in Canada. All completed EQuilibrium homes are planned to be open to the public for a minimum of six months and, when sold and occupied, the homes will be monitored. A number of the homes are now completed, and some are in the monitoring phase.

These homes are designed to essentially be net zero energy homes – homes that over the course of a year will generate all of the heat and electricity required by the home. This is meant to be achieved by a combination of energy conservation, solar energy contribution, and renewable energy generation on site.

EQuilibrium homes are not focused only on energy. They are also designed to be healthier and more resource-efficient than traditional housing, following the five core principles:

1. Occupant health
2. Energy efficiency
3. Resource conservation
4. Low environmental impact
5. Affordability

To achieve net zero energy and minimize the energy required to operate the house, it is necessary that the design starts with an airtight, highly insulated building envelope (walls, ceiling, windows, doors, and foundations) that incorporates passive solar heating. It also requires that the home be equipped with very efficient appliances, lighting and HVAC equipment motors. The domestic hot water and space heating needs are then supplied by passive and active solar heating systems with a backup heater (typically electric).

Analysis of the homes is done with NRCan's HOT2000 energy simulation software, using a modified calculation to estimate annual energy consumption and customized EnerGuide ratings for each home. The energy efficiency of the home's building envelope, using standardized mechanical systems and no renewable energy applications, had to be at least ERS 82, although most were able to achieve a few more points. Then the effect of reduced electrical energy use (by design of systems and equipment selected), passive solar gains, hot water use patterns and mechanical and renewable energy systems were factored in with the objective of achieving an ERS rating of 100.

Solar heat collected is either used by the house directly at the time of its production or stored for later use. All solar electricity produced is either used by the house directly at the time of its production, or supplied to the electrical grid. Any supply to the grid offsets the electricity that was purchased at another time in the year. This yields a net zero annual energy purchase.

All the homes incorporate solar electric or photovoltaic (PV) systems, which is an expensive technology today, although prices are declining. However, Building Integrated PV (BIPV) is a technology that is becoming more common in some parts of the world, especially on larger commercial projects. BIPV is typically a PV system built in or roughed in for later installation or is integrated into some of the building components such as the roofing shingles.

Three EQuilibrium homes have real time monitoring of their PV electrical generation that is linked to the Internet. Fig A shows the lifetime

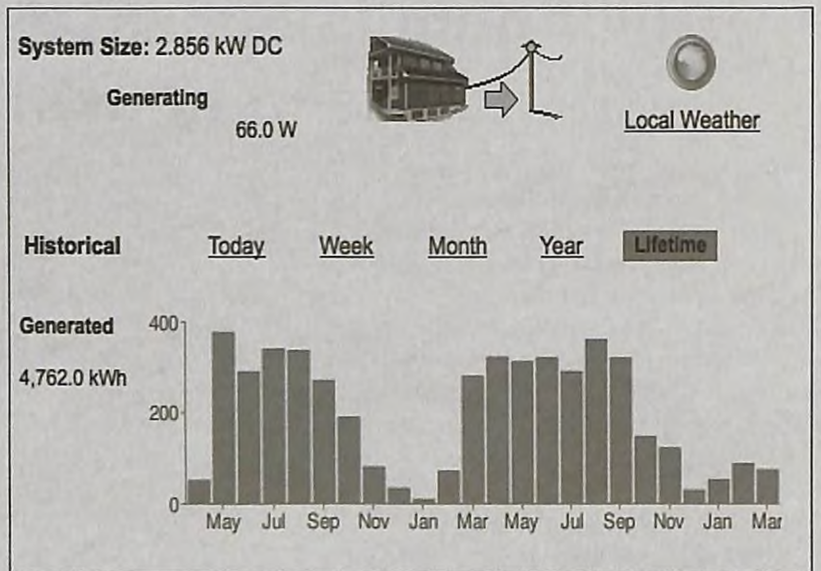


Fig. A. Solar electric generation output of the PV system at the ÉcoTerra™ home in Eastman, Quebec. This graph shows the total electrical generation - it is also available on a daily, weekly or monthly basis. Similar graphs are available for all the commisioned EQuilibrium homes.

Information on the EQuilibrium houses is available at the CMHC web site:
www.cmhc-schl.gc.ca

monitoring results for the ÉcoTerra™ home in Eastman, Quebec, southeast of Montreal. Results viewable on-line provide daily, weekly, monthly, annual or lifetime electrical generation from their PV systems.

Energy modelling of the house at the design stage is important to help optimize the design. It is also useful as an educational tool for all concerned.

Lessons are already emerging from the first homes that are being occupied. Generally, the performance is approaching the predictions; however, people who live in the homes don't necessarily live according to the modelling assumptions.

Conservation is the simplest and most cost effective option to achieve the high performance needed for high performance homes. Building envelope components – walls, ceiling, windows, foundation -- are easy to upgrade during construction and are permanent with no moving parts or maintenance to be concerned with. Properly installed, in an airtight envelope, there are no commissioning issues unlike with mechanical systems.

Passive solar energy is inexpensive as it provides significant portions of space heat requirements without any special equipment. However, passive design must be carefully factored in to the design and controls used for the HVAC system to ensure not only energy savings but also homeowner comfort.

Mechanical systems, on the other hand, are complex and require proper design, installation, commissioning and maintenance. The more complex the system, the more options there are for less than optimum performance. ☼

Gold Coat: Corrosion Resistant Connectors

Metal connectors, anchors and fasteners will corrode and lose load carrying capacity when installed in corrosive environments or when exposed to corrosive materials. Corrosive environments include locations close to ocean salt air, fire retardants, dissimilar metals, fertilizers, and preservative-treated wood.

Changes have been made to wood treatment chemical formulations with higher concentrations of copper. While the use of copper is more environmentally friendly than arsenic, the end result is a product that more readily corrodes steel. This has raised concerns about appropriate details, connectors and fasteners that can be used.

Historically, structural connectors were made from steel coated with zinc. Zinc provides galvanic protection in the form of a "sacrificial metal". This type of protection occurs because zinc is a more reactive metal than the underlying protected metal.

Depending on the type and thickness of the steel, the zinc may be applied either before or after the product is manufactured. For thinner material connectors, zinc is applied during the manufacturing process. Thicker products are submerged in a bath of molten zinc called hot dipped galvanizing. As a sacrificial protection, however, it inherently has a finite life – as long as corrosion conditions are present, the protection can wear out.

Connectors may also be made from stainless steel material or painted. Stainless steel offers the best corrosion protection available.

Painting is not intended to provide long-term corrosion protection, but rather short-term protection such as during shipping to a job site. Painting is normally done after the product is fabricated and done by dipping the product.

USP Structural Connectors have developed a protective barrier for metal connectors and fasteners. Marketed as Gold Coat, it is a proprietary organic polymer coating that is engineered to resist the corrosive properties of the chemicals used in pressure treated wood. Gold Coat is designed with corrosion inhibitors to address the electrochemical reactions of connector and fastener corrosion. Adding a barrier prevents the highly corrosive interaction between copper, zinc and steel.

Information:
USP Structural Connectors
http://www.uspconnectors.com/corrosion.shtml

Corrosion 101

Corrosion is a complicated reaction influenced by many factors such as dissimilar metals, moisture, and environmental chemicals. However, structural connectors and their fasteners are attacked by corrosion in the same basic electrochemical manner.

In a wet environment, corrosion happens when an electrolyte transfers ions from one material to another. With connectors it is the steel that loses its electrons to the environment. For this reaction to occur the electrolyte must be in contact with the metal.

Internal Attack - Copper ions found in high concentrations in treated wood are positively charged and actively attack the negatively charged steel. Traditional corrosion protection is a barrier layer of zinc that is more negative than steel and attracts the copper ions, thus temporarily protecting the steel. Once the copper eats all the zinc away, the steel is aggressively attacked. Zinc is really just a sacrificial delay.

External Attack - Outside factors such as moisture (especially wet/dry cycles), acid rain and chemicals, all serve to accelerate the attack on the steel.

Climate Change: Impacts on Housing

It is accepted that we are committed to at least 40 to 50 years of climate change, whatever we do now, and in the future, to reduce our CO_2 emissions.

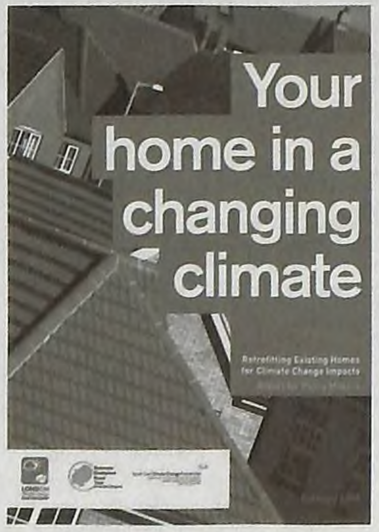
Households will be particularly affected by climate change, summer heat waves will make homes uncomfortable, while more frequent and severe flooding and reduced water availability may expose homes and their occupants to greater risks unless action is taken.

That is the opening of a report for the local governments in the London, England region.

The UK government has noted that the UK climate has already started to change, and the changes are projected to accelerate, so policy makers are taking action to prepare for the adaptation to changing conditions.

The southern part of the UK, having large areas of low-lying land, is already seeing more flooding. They are also seeing stress on water supplies with longer dry spells along with a growing demand due to population growth. In summer, prolonged heat spells will lead to overheating of buildings, necessitating greater use of air conditioning in a region of the world where that has not been the case. Increased use of air conditioners means more energy use, which has an impact on CO_2 emissions.

With UK housing stock turnover of about 1% per year, it is clear that the majority of homes built, even by 2050, have already been built, so it is important that programs and actions that need to be taken will be able to capture existing housing stock more than just new construction.



While this is a UK study, dealing with UK issues, there are lessons there for any part of the world since the underlying issue knows no boundaries. Significant changes in climate conditions have been observed in many parts of Canada.

It is possible and cost effective to improve existing housing stock to adapt to changing climate conditions. Small changes can have a big impact when factored across many thousands of homes, especially when water conservation and energy efficiency measures are taken.

In Canada, although impacts of climate change may vary from region to region, there will be changes. We have an infrastructure that has been built up over time by the variety of energy efficiency programs that have come and gone over the years.

The principal initiative has been NRCan's ecoEnergy program (formerly called Energuide for Homes) that offers effective diagnostic information for homeowners, and some modest incentives for actions taken. Several provincial and regional programs have at times piggy-backed on the Energuide program. Regrettably, the EcoEnergy program has just been cut back by the current government.

However, for retrofitting to be effective, it must be delivered by trained professionals with suitable skills. The follow-up has not always been consistent. This provides an opportunity for renovators to show, in an organized manner, a way to deliver results.

The UK report is one indication of how seriously the issue of climate change is being taken around the world. Living in Canada, being exposed to North American media, we still see a lot of noise generated by those who deny that there is climate change taking place. Regrettably, they have the ear of the highest public policy makers who use the 'debate' and 'doubt' to avoid taking action. The sudden cutback of the ecoEnergy program is another example where public policy in Canada simply does not seem to follow facts, but rather follows the ideological bent of the environmental sceptics. ☼

Proposed Energy Code Changes in BC

The BC government has made a commitment to set in place aggressive energy standards in the building code. The Province is developing Building Code change proposals to require energy performance for new Part 9 housing that, combined with provisions under the BC Energy Efficiency Act, will be equivalent to EnerGuide 80 in 2011. This is seen as the first step to even more aggressive requirements in the coming years.

The current review process is building on previous changes to "green" the Building Code that enshrined EnerGuide 77 as the code requirement, although in practice the current prescriptive alternative falls far short of that target.

The approach that is being considered will offer three paths to compliance: performance targets for thermal resistance and airtightness; prescriptive requirements for thermal resistance and airtightness in the Building Code; and deemed to comply third party certification, such as R-2000, Built-Green BC, LEED or EnerGuide.

The performance path will establish performance targets that must be met for overall thermal resistance and airtightness of the building envelope (including windows). There is also discussion about the establishment of performance targets for airtightness, and how compliance is to be determined. There is a strong likelihood that third party airtightness testing of completed homes may be required.

The prescriptive path will set out fairly conservative minimum requirements so that when built, the average house should rate an EnerGuide 80. The new requirements will focus attention on air barriers; the minimum insulation requirements will be upgraded, and will also include measures to deal with thermal bridging.

In addition, there is recognition that ventilation requirements need to be addressed, so there is ongoing discussion about what those requirements should look like.

The third compliance path will be a "deemed-to-comply" path, relying on third party certifications such as EnerGuide, R-2000, Built-Green-BC™ or LEED Canada for Homes.

Other items being considered include requirements to make homes solar ready (for solar water heating) where practical, requiring high efficiency toilets (including dual flush) and urinals in new construction, and including code language to support use of non-potable water for toilet flushing, irrigation and cold water clothes washing.

While these are the broad outlines of the proposed changes, much is still under discussion. A number of questions have been identified, including; whether these broad targets are achievable; what the role of homeowners will be; what would the following code (2015) look like; how should district energy systems and other alternatives be considered; what will be the impact of these new standards on housing affordability? The Ministry will have an online public review starting in May.

Details:
http://www.housing.gov.bc.ca/building/green/index.htm

"By 2020, my challenge to you is to be building housing that is net zero for GHG emissions with superior air tightness and insulation that will enable net zero energy performance through the addition of renewable energy generation such as solar panels."

Rich Coleman, Minister of Housing (BC)

Proposed BC Building Code Housing Energy Performance Requirements

Region	Air Change/hr	Effective U-Value (RSI - W/m²K)		Effective R-Value (ft² °F h/BTU)	
		Single family	Row housing	Single family	Row housing
Northern	2.5	0.250	.210	22.7	27.0
Interior	3	0.275	.240	20.6	23.7
Lower Mainland	3.5	0.345	.326	16.5	17.4

Canadian Home Builders' Association

Technical Research Committee News

Codes and Standards

2009 marks the end of the cycle for the 2010 National Building Code (NBC) and the start of the 2015 Code cycle. Comments from the public review conducted in the fall of 2009 have been reviewed and the text is being finalized. The process is actually a continuous one, but the Standing Committee on Houses and Small Buildings works on a 5-year mandate, so that a major revision is issued every five years.

Perhaps the major change coming in the future will be the introduction of energy efficiency standards. A new energy efficiency objective for the code has been developed. Changes in code energy standards are coming, and coming fast.

An updated version of the National Energy Code for Buildings (NECB), which applies to larger buildings built under Past 3 of the NBC, is scheduled for publication in 2011. However, since the Model National Energy Code for Houses (MNECH) has not really been used since it was first drafted in the mid-1990s, it was considered most appropriate not to develop a new edition, but rather to incorporate energy standards as a separate section within the National Building Code.

A number of provinces have already implemented, and are currently updating, energy efficiency standards for small residential buildings. CHBA has been supportive, encouraging the updating of the MNECH to create a uniform standard, to avoid varying regional requirements.

Work is now progressing at the Canadian Codes Centre, with the intent of developing a separate section to be inserted into the National Building Code. A study to document the current energy efficiency practices in houses, as well as current and planned provincial energy efficiency requirements is being done to assist the code development committees. This will be important in assessing the impacts of any new proposed energy efficiency requirements.

The intent is to have draft energy efficiency requirements developed and made available for public comment in Fall 2011, with a release as an interim change to the code in 2012. The energy regulations will apply to all buildings constructed under Part 9 of the building code – this will include small, non-residential buildings that previously were excluded.

R-2000 Standard and EnerGuide Rating System

CHBA has been working with NRCan on plans to introduce the next generation of the R-2000 Standard. Proposals developed by CHBA form the basis for the renewal of the standard. The intent is to maintain R-2000 as the standard for evaluation of "best in class" energy and environmental performance of houses. The direction for the standard is to reduce the energy target – although precise details are yet to be finalized, the target is slated to move to a level that will be about 50% better than the current R-2000 Standard, which would mean an EnerGuide rating in the range of 86+. The work is being led by a multi-party committee with representation from across Canada.

A similar process is being initiated by Natural Resources Canada for a review of the EnerGuide Rating System (ERS). This was developed in the late 1990s as a tool to primarily assess the energy efficiency of existing houses as a backup to energy efficiency retrofit initiatives. More than 800,000 homes have now been evaluated.

Over the years, the ERS has started to be used not only for existing houses, but also for new construction. Increasingly, local authorities are relying on it as a regulatory tool, even though it was not designed with that in mind. That is why a review is now underway, to make it possible to use the system in a regulatory manner. It will also be reviewing appropriate changes to make it easier to directly recognize new zero energy homes (rating 100) which is not the case at the moment because of the structure of the formula that calculates the ERS.

The ERS review will also standardize and clarify underlying assumptions in order to offer stability for stakeholders so that any changes that may need to be done in the future will be done in a manner similar to that used in code and standards development.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca
www.chba.ca

Energy Efficiency in MURBs

Although single-family homes have generally quite high performance standards, driven by changed construction practices and stringent prescriptive energy efficiency standards in some provincial and regional buildings codes, the same is not the case with multi-unit residential buildings, especially high-rise apartment towers.

A study that is still underway for the Home Owner Protection Office in BC is looking at the energy consumption in high-rise buildings. It has been noted that despite standards that require more energy efficient construction, the energy consumption in high-rise rehabilitated buildings has not been going down as much as could be expected.

The study has found a number of contributing factors to explain the poor energy performance of these new buildings. One significant factor is the widespread use of direct vent gas fireplaces that are not separately metered, but are frequently being relied on as a heating source.

The other major factor is the poor design and detailing of the building envelope. The overall R-value of the exterior building envelope is often in the range of R-3. This is accounted for by larger glazing areas, use of lower performance windows, poor detailing that does not properly deal with thermal bridging through the structure, and air leakage through an envelope that is not airtight.

Whitehorse Building Regulations

(Winter design temperature -43°C; 6900 DD°C)

The City of Whitehorse has introduced new stringent minimum insulation values:

All walls, ceilings, and floors separating heated space from unheated space and the exterior air or soil, must have insulation values not less than:

- Walls including foundations above and below grade: RSI 4.9 (R28).
- Ceilings throughout: RSI 8.8 (R50).
- Floors above unheated spaces: RSI 4.9 (R28).
- Slabs-on-grade: RSI 1.8 (R10).
- Heated Slabs-on-grade: RSI 3.5 (R20)
- Concealed floor space or crawl space from grade: RSI 1.8 (R10)

Alternatives to the prescriptive insulation requirements may be determined by computer modelling resulting in an equivalent performance or achieving an EnerGuide Rating System value of 80.

Doors excluding glazing must have a minimum thermal resistance of RSI 2.1 (R-12).

Windows and glazing installed must have a minimum thermal resistance U value of 1.6W/m²•K (R-3.6).

Insulation of not less RSI 1.8 (R-10) must be installed around the perimeter of a building extending not less than 600mm (2') from the building face immediately above or at footing level.

The building enclosure of new dwelling units must be built airtight, to the same standard as R-2000 homes: a maximum 1.5 air changes per hour at a 50 Pa depressurization or a maximum normalized leakage area of 0.7cm²/m² of exterior wall surface.

Heat Recovery Ventilators with a sensible recovery efficiency of 64% or more at an outside winter design temperature of -25°C must be used as the principal ventilation fan to satisfy code ventilation requirements (9.32.3.3 (1) a) of the National Building Code).

Energy Standards Overseas

We are often insulated from happenings in other parts of the world. For years, we in Canada have revelled in the knowledge that the R-2000 Standard was the world standard for high performance energy efficient residential construction. However, in recent years Europeans and others have made a commitment, as part of their commitment to tackling global climate change issues, to bring their standards and practices to levels that within a few years they will be building homes and buildings that are net zero carbon.

The equivalent of today's R-2000 energy target is becoming code in many places (including some Canadian jurisdictions).

In the UK, which has a reputation for drafty, poorly insulated homes, many homes were built with no insulation until recently – because there were no standards. Today that has changed, with the requirement for highly insulated building envelopes. On paper, today's minimum UK requirements exceed levels of insulation needed to meet today's Energy Star or R-2000 Canadian requirements – except that the Brits have not quite recognized the importance of air sealing, as they accept an airtightness level of 10 air changes per hour (which itself is a significant improvement on their past practice).

In Germany and Austria, the Passivhaus is setting the standard, with a performance target of 15 kW/m²/year for space heating, and an air tightness level of 0.6 ACH. ☼

Energy Answers: A Tale of Two Buildings

Have you got some examples of exemplary and not so exemplary Canadian buildings?

Rob Dumont

While in Edmonton recently, I had a chance to see two interesting buildings.

The first was a multi-family residential building built in 2000. The building is a 55 unit co-operative built on the north edge of the North Saskatchewan River valley close to downtown. Communitas of Edmonton was the developer. The building faces south. It was completed in 2001.

I received a tour of the building thanks to Brian Scott and Lynn Hanley of Communitas on the evening of March 15, and was so intrigued I returned the next day to take some photos.

Fig 1. Grandin Green - South elevation

Fig 2. Grandin Green, East elevation

This building is quite energy efficient compared with its peers. It consumes about 195 kWh/ m² per year. For comparison, a survey of Saskatchewan high-rise apartments found an average annual consumption of 410 kWh/m² per year. Grandin Green is thus using about 52% less energy on an equivalent floor area basis in roughly the same climate zone as the Saskatchewan multi-family buildings.

This energy efficiency translates into a dollar saving of about $150 per month per suite. Some of the innovative features of the building include the following:

- ☞Unobstructed South orientation – An innovative floor plan that provides each of the four suites on each floor with a generous south view
- ☞Use of Visionwall high performance windows with their high R-value, relatively good solar transmittance, excellent durability, and very good sound isolation
- ☞External shading of some of the south windows by the balconies to limit solar gain in the cooling season
- ☞Minimal windows on the north side of the building, which contains the elevator, some bedrooms, and not much of a view
- ☞Compartmentalization of the suites to minimize the stack effect and accompanying air leakage. Cross transfer of cooking odours, tobacco smoke, etc. is also greatly reduced.
- ☞A peel and stick membrane attached to the outside of the exterior gypsum board to ensure a well-sealed exterior envelope
- ☞Individual heat recovery ventilators in each suite, which ensure ventilation of each room in the suite. In addition, space is saved in the penthouse because large central equipment is no longer needed.
- ☞Mid-efficiency boilers

Water consumption in the building is 114 cubic metres per suite per year, a 47% reduction from the average of 216 cubic metres per suite per year for a group of 88 multi- family buildings across Canada.

In a comparison of energy use of innovative multi-family buildings across Canada, Grandin Green was found to use 36 watt-hours of energy per square meter of floor area per heating degree per day. This value was better than that of three other large multi-family buildings also built incorporating energy efficiency features.

The innovative features for the building were financed in an equally innovative manner. As noted in the CMHC report, "the incremental costs associated with the many innovations embodied in the building were financed through a "green" loan of approximately $20,000 per suite. The monthly interest charges per suite for the green loan are offset by the monthly energy savings."

Some retrofits that were recommended in the CMHC Innovative Buildings Report were the use of condensing boilers, which are now (2010) more readily available, ECM motors (brushless direct current) on the heat recovery ventilators and fan coils (now also more readily available), and changes to the basement parking lot temperature setting and the common hallway ventilation.

Grandin Green is a most impressive building. Natural Resources Canada through the Commercial Buildings Incentive Program was one of the sponsors for energy innovation in the building.

A new multi-family complex, Station Pointe, is to be built in northwest Edmonton by Communitas, the developer. The complex will build on the strengths of Grandin Green. Station Pointe, however, will have a target of near net zero energy consumption.

Art Gallery of Alberta

The Art Gallery of Alberta opened in downtown Edmonton in January 2010.

Fig.3 Art Gallery of Alberta, northwest view

The appearance of the building reminds me of a comment, "It's the kind of thing you like if you like that kind of thing." The chief architect for the building is Randall Stout of Los Angeles, and I wonder if he has ever visited Edmonton in winter.

According to an Edmonton Journal article on March 16, 2010, the building cost $88 million dollars and has an exhibition space of 30,000 square feet. And according to a Macleans Magazine article, the "cost of construction, initially estimated at under $30 million, checked in at $88 million." Assuming that the building has another 30,000 square feet for administration, programs, common areas, gift shop, restaurant, etc., the price per square foot is about $1500 per square foot. For comparison, new institutional buildings of a conventional nature cost roughly about one-fifth that amount these days in Canada.

The gallery was closed at the time we wanted to visit, but I did take a quick look inside.

Fig. 4 Entrance doors.

A couple of things struck me about the building science aspect of the building. As you can see from the doors, they consist of single pieces of thick glass. There is no weatherstripping at the vertical joint of the two doors, and you can see daylight under the right hand door.

While looking at the building, I saw some workers tearing up part of the steps for the new building. The step treads and risers are not concrete but a type of cut stone. If you look carefully in the picture you can see that they have broken one of the treads while opening up the assembly.

I asked why they were doing the work. The answer was that there are pipes carrying warm glycol that passes underneath the steps in order to melt snow. The glycol system is not working and they are trying to find the problem.

Fig. 5 Workers repairing the steps of the building

As a former researcher, I tend to look a lot at evidence and draw conclusions. Here are a few that quickly come to mind.

1. The building envelope is incredibly complicated. We have difficulty in constructing regular rectangular buildings that don't leak water and have condensation problems. An art gallery typically has to maintain a high interior relative humidity to meet accreditation standards, which adds to condensation problems.

2. Certain aspects of the building such as the single-glazed front doors with no weatherstripping are very poorly detailed and highly inappropriate for a cold climate like Edmonton, where the annual average temperature is about +2°C.

3. Using a glycol loop to melt snow is a very energy intensive operation. Most buildings in that climate seem to do fine with manual shovelling of snow. ☼

Further descriptions of the Grandin building are available at
http://www.helix-industries.com/grandingreen/index.htm
http://www.cmhc-schl.gc.ca/en/inpr/bude/himu/inbu/loader.cfm?url=/commonspot/security/getfile.cfm&Pa geID=118853

NRC·CNRC

A Summary of NRC-IRC Housing Activities for 2009

This article presents highlights from the NRC-IRC housing activities report prepared for the 2010 annual conference of the Canadian Home Builders' Association.

By John Burrows

Building Envelope and Structure

Window/Wall Interface Details for Managing Rainwater and Air Leakage: The evaluation of the condensation risk at the window frame with various installation details subjected to low temperatures and air leakage across the interface has been completed. Several articles, including one in Home Builder, along with two major reports, have been published. Further information is available at:
http://www.nrc-cnrc.gc.ca/eng/ibp/irc/ci/volume-11-n2-1.html

Heat, Air and Moisture Movement in Wall Assemblies: The NRC-IRC wall research house is the site of studies of innovative wall assemblies. In the winter of 2009, one project investigated the potential for wintertime moisture accumulation when XPS foam was added as external insulation over an insulated wood-frame assembly. A second project investigated the performance of a wood-frame wall with and without the designated polyethylene vapour barrier. Information is available at:
http://www.nrc-cnrc.gc.ca/eng/projects/irc/innovative-systems.html

The Indoor Environment

Indoor Air Initiative: In 2009, NRC-IRC commissioned its new full-scale laboratory for research on air quality and ventilation. Initial experimental work is examining air supply, air distribution and air movement within residential buildings in support of an indoor air quality field study in the homes of approximately 100 families with asthmatic children. The objective is to improve understanding of the impact of ventilation and air distribution on indoor air quality.

Hybrid Heating and Ventilation Systems: Researchers are currently running experiments investigating the effectiveness of ventilation when diffusers are placed in non-traditional locations (i.e., not under windows). The results will quantify the difference in performance in terms of ventilation effectiveness, predicted occupant comfort and energy use. Reports and published papers are available at:
www.nrc-cnrc.gc.ca/eng/ibp/irc/publications/index.html

Indoor Air Quality Technologies and Solutions This project is evaluating ways of removing air contaminants and improving indoor air quality. Portable air cleaners (PAC), commercial air duct cleaning (DC) and heat/energy recovery ventilators (H/ERV) are scheduled for study. More information is available at:
http://www.nrc-cnrc.gc.ca/eng/projects/irc/innovative-systems.html

Mould Research This research project is addressing three issues: mould-detection techniques, the potential for mould growth on building materials and components, and remediation methods. New laboratory facilities for the study of mould growth on building materials were commissioned in 2009; in 2010, the first experiments will begin.

Developing and Demonstrating Zero-Peak Houses NRC-IRC has begun a project that will explore the potential to reduce household electricity use dramatically, perhaps to zero, through more efficient house design and appliances, shifting demand to off-peak times with advanced controls, changes in occupant behaviour, and local power generation and storage. For details, see:
http://www.nrc-cnrc.gc.ca/eng/projects/irc/zero-peak.html

Guidelines for Effective Solar Shading Devices Researchers have completed the development of guidelines for the effective use of exterior, between-pane and interior, highly reflective shading devices for residential windows. These will be available soon. Published articles can be downloaded from:
http://www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/nrcc51405.pdf
http://www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/nrcc51256.pdf

Fire Safety

Performance of Protected Ceiling/Floor Assemblies in Basement Fire Scenarios The objective of this new project is to study the fire performance of engineered ceiling/floor systems protected by measures such as gypsum board, sprinklers or other protection systems. The results will help to better understand how innovative construction products and systems affect the fire safety of occupants in single-family houses.

Smoke Movement Studies in a Dwelling with a Secondary Suite NRC-IRC recently completed smoke movement studies in a residential building with a secondary suite located in the basement. The results formed the basis of changes to Part 9 of the National Building Code. The full report is available on the NRC-IRC website:
http://www.nrc-cnrc.gc.ca/obj/irc/doc/pubs/rr/rr297.pdf

Development of the National Construction Codes

The final public review of proposed changes for the 2005-2010 code cycle was completed. Major changes include: provisions to provide additional protection from the ingress of radon into buildings; a new harmonized window standard for windows, doors, and skylights; a three-level risk-based approach for design for lateral loads; and additional fire protection requirements for construction of buildings and houses in close proximity to one another or close to the property line.

Following consultations with the provinces and territories, a decision was made to establish energy efficiency as a new objective in the National Construction Codes.

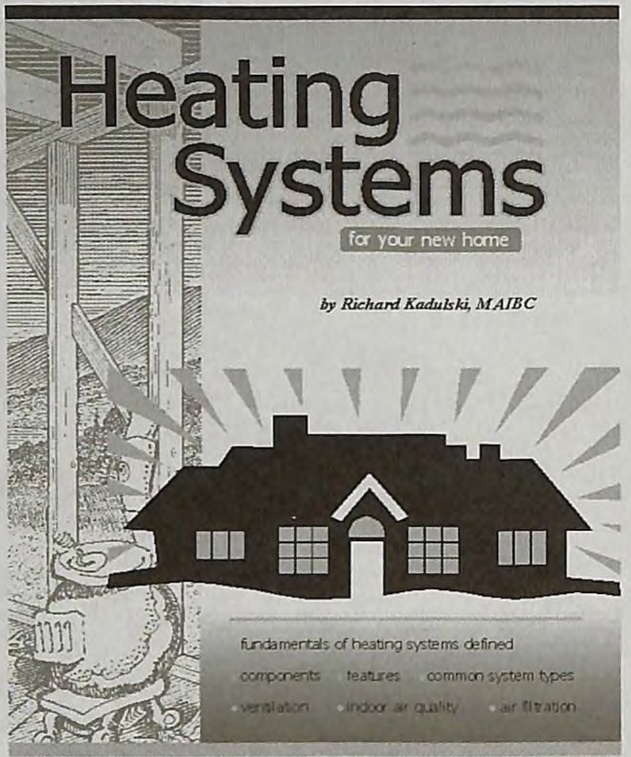
Construction Materials Evaluation

A survey of Canadian building officials and manufacturers yielded insights on the services offered by the NRC Canadian Construction Materials Centre (NRC-CCMC). Suggested new fields for evaluations include energy efficiency, water conservation, and sustainability. NRC-CCMC is analyzing the survey findings to determine changes needed to better meet client expectations.

Canadian Centre for Housing Technology

In 2009, the Canadian Centre for Housing Technology (CCHT) carried out a number of experiments including the following: evaluation of an advanced integrated mechanical system (combined space-heating, hot water heating and heat recovery ventilation); study of a Stirling hybrid forced-air system; evaluation of a novel design of residential water heater; study of an air source heat pump. Projects for 2010 will address the following: ultra-high efficiency solar cells; water recirculation loop; gas fireplace operation in an open-concept R-2000 home; solar thermal heating. More information on CCHT is available at:
http://www.ccht-cctr.gc.ca

John Burrows is an Ottawa-based consultant and technical writer.



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